

WHAT IS CLAIMED IS:

1. A support frame for a flexible leaflet prosthetic heart valve, comprising:
a plurality of cusps each sized and shaped to support a cusp of a flexible leaflet of the heart valve; and
a plurality of commissures, one each between each adjacent pair of cusps, the commissures each having a point of weakness designed to fracture upon repeated relative movement of the cusps after implantation such that the cusps move substantially independently of each other.
2. The support frame of claim 1, wherein the support frame is a single, continuous, element.
3. The support frame of claim 2, wherein the support frame is formed from a continuous, homogeneous material.
4. The support frame of claim 3, wherein the commissures and cusps have substantially the same material stiffness in bending prior to reaching the point of fatigue.
5. The support frame of claim 1, wherein the support frame is made of Nitinol.
6. The support frame of claim 1, wherein each cusp of the support frame transitions into two commissure regions, and wherein the point of weakness at the commissures comprises a frangible bridge between adjacent commissure regions.
7. The support frame of claim 6, wherein the frangible bridge comprises a narrow portion of the support frame relative to adjacent portions.
8. The support frame of claim 6, wherein the point of weakness comprises a notch.

9. The support frame of claim 6, wherein the commissure regions terminate in enlarged ears on either side of the frangible bridge.

10. The support frame of claim 9, further including a biocompatible fabric covering the support frame, and wherein the enlarged ears are sized to prevent the commissure regions from poking through the fabric once the frangible bridge has fractured.

11. A support frame for a flexible leaflet prosthetic heart valve, comprising:
a plurality of cusps sized and shaped to support cusps of flexible leaflets of the heart valve; and
a plurality of commissures, one each between each adjacent pair of cusps, the commissures and cusps being formed integrally of a homogeneous material and the commissures each having a point of weakness designed to fracture upon repeated relative movement of the cusps after implantation whereby the cusps can move substantially independently of each other.

12. The support frame of claim 11, wherein the support frame comprises three cusps and three commissures.

13. The support frame of claim 11, wherein the support frame is made of Nitinol.

14. The support frame of claim 11, wherein each cusp transitions into two commissure regions, and wherein the point of weakness at the commissures comprises a frangible bridge between adjacent commissure regions.

15. The support frame of claim 14, wherein the frangible bridge comprises a narrow portion of the support frame relative to adjacent portions.

16. The support frame of claim 14, wherein the point of weakness comprises a notch.

17. The support frame of claim 14, wherein the commissure regions terminate in enlarged ears on either side of the frangible bridge.

18. The support frame of claim 17, further including a biocompatible fabric covering the support frame, and wherein the enlarged ears are sized to prevent the commissure regions from poking through the fabric once the frangible bridge has fractured.

19. A method of replacement of a natural heart valve with a flexible leaflet prosthetic heart valve, comprising:

providing a flexible leaflet prosthetic heart valve having an internal support frame with alternating cusps and commissures, the cusps of the flexible leaflets being attached along the support frame cusps, the commissures of the internal support frame being designed to fracture upon repeated relative movement of the cusps after implantation such that the support frame cusps move substantially independently of each other; and

implanting the flexible leaflet prosthetic heart valve.

20. The method of claim 19, wherein the internal support frame is made of a continuous flexible element which will withstand and spring back from substantial compressive forces imparted thereon during the implanting step.

21. The method of claim 19, wherein the step of implanting the flexible leaflet prosthetic heart valve comprises compressing the valve and delivering it to the site of implantation through a tube in a less-invasive procedure.

22. The method of claim 19, wherein the flexible leaflet prosthetic heart valve is designed to be implanted in the aortic position and further includes a sewing band that

follows the alternating cusps and commissures of the support frame, and wherein the step of implanting comprises attaching the sewing band up and down the fibrous cusps and commissures of the natural aortic annulus and ascending aorta.

23. The method of claim 19, wherein the commissures of the internal support frame are designed to fracture from between about two days and two weeks after implantation.